

# Mill Site Decommissioning Design

(TAILINGS PILES STABILIZATION)

Report to

Silver King Mines Inc.  
TVA Project  
Edgemont Mill Decommissioning

Report No. 9

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in association with **Golder Associates**

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## 6.0 SITE RESTORATION PLAN

### 6.1 Introduction

The objectives for restoration remain the same as those stated in Section 2.2.2.7 of the FES (Ref. 6). They are as follows:

- Stabilize soil at the mill site
- Make the site available for productive use
- Restore the riparian community in the rechannelled portion of Cottonwood Creek, producing habitat for indigenous wildlife, and improving the scenic quality of the creek.

The restoration program for the mill site involves regrading the post-excavation landscape of the site in preparation of the seedbed application, seeding and shrub planting. Drawing Nos. 18 and 19 illustrate the restoration grading, including earthwork requirements, using a base contour plan of post-excavation conditions. Table 6-1 summarizes the earthwork requirements for each restoration area and the total grading requirements for the mill site. The post-excavation condition is used as a basis for discussing site changes for restoration, particularly with respect to grading.

### 6.2 Excavation and Regrading

The post-excavation landform is similar to the landform which existed on the mill site before milling operations. No extensive regrading will be required to restore a scenic

TABLE 6-1

MILL SITE RESTORATION GRADING

<u>Restoration Area</u>	<u>Surface Area (ac)</u>	<u>Topsoil Required (cu. yd.)</u>	<u>Cut to Fill Quantity (cu. yd.)</u>	<u>Additional Fill (cu. yd.)</u>
Pond 1 and Cheyenne floodplain	11.22	9,050	24,830	-
Sand Tailings Area A and adjacent BNR Property	13.39	10,800	33,670	-
Cottonwood Creek floodplain	20.14	14,210*	20,350	6,420**
Pond 2 and Cheyenne floodplain	9.73	7,850	18,900	-
Sand Tailings Area B	8.33	6,720	15,780	-
Mill Building Area	15.64	12,620	17,320	-
Open Area south and west of Pond 1	9.27	7,480	-	-
Pond 3 and adjacent sewage lagoon	13.99	11,280	40,970	-
East Sand Tailings Pile	14.35	11,580	55,140	-
Ponds 4, 5 and 6	5.52	4,450	3,840	3,480***
Pond 7	37.42	30,180	26,320	69,800***
Pond 8 and adjacent sewage lagoon	8.43	6,800	8,960	7,290***
Pond 9	5.34	4,310	6,270	4,020***
Pond 10	29.81	20,950	29,330	38,940***
Pine Hills Area	27.83	-	-	-
Facilities Area	19.54	15,760	-	-
Total	249.95	174,050		130,000
Haul Road Station Station 5106+00 to Station 5197+00	15.67	12,650		
TOTAL	265.62	186,700		

\* Considers undisturbed areas where no topsoil cover is required.

\*\* Additional fill for Cottonwood Creek floodplain is available from Sand Tailings Area A and B.

\*\*\* Additional fill required from the Disposal Site.

landscape similar to the pre-operation condition. The steepness and length of slopes illustrated on the restoration plan are similar to those which existed before milling operations, and consequently, after the initial period of soil stabilization, there will be a comparable rate of erosion to that which existed before milling operations.

The entire land surface within the mill site will be disturbed through excavation activities except for a few locations within the Cottonwood Creek floodplain area. These undisturbed areas are either uncontaminated steep valley banks which are actively eroding, or open lands at the south end of the Cottonwood Creek floodplain beyond the limit of contamination.

In preparing the restoration plan, the following objectives were set:

- Grading should eliminate or modify existing and post-excavation landforms created during the milling operations (i.e. dikes)
- Positive drainage should be restored throughout the site with no increased runoff into neighboring land, particularly Cottonwood Community
- Soil movement (cut and fill operations) should be minimized and a balance of excavation and fill achieved in areas where such activities would not significantly change the natural landform

- A two-foot layer of clean fill material should be placed over the base of ponds or sand piles to cover any residual contamination that may remain (see Section 3.2)
- Grades of one per cent minimum should be provided for positive drainage, and a 3:1 maximum slope to allow safe operation of equipment for top soil spreading, fine grading, disking, seeding and mulching.

To explain the regrading requirements of the mill site, each restoration area with similar grading requirements has been grouped into one of four categories. The following section describes each of the categories, lists the applicable restoration areas and describes the grading procedures.

#### 6.2.1 Diked Areas within the Pre-Operational Cottonwood Creek and Cheyenne River Valleys

- Restoration areas:
- Sand Tailings Area A and adjacent BNR property
  - Pond 2 and Cheyenne floodplain
  - Pond 1 and Cheyenne floodplain
  - Sand Tailings Area B
  - East Sand Tailings Pile

In these areas, the excavation of contaminated material will leave large shallow depressions in some cases below the groundwater level. In these situations, fill will be required to raise the ground elevation allowing a one per cent minimum slope toward Cottonwood Creek or the Cheyenne River (additional filling due to groundwater conditions may also be required). For each of these restoration areas, the fill material can be acquired from within the boundaries of the

area without extensively altering the desired valley landform. Three primary sources of on-site fill material are:

- Existing dikes
- Borrow areas (usually small hills formed within the Cottonwood Creek Valley before mill operations, and subsequently covered by tailings)
- Regrading valley walls formed after the excavation of contaminated material.

In the case of "Sand Tailings Area A and adjacent BNR property", the required fill material is available from the existing dikes bordering Cottonwood Creek and a small height of land located in the center of the area. The fill available from these two sources should also provide a surplus for use in filling depressions within the adjacent section of the Cottonwood Creek floodplain.

In "Sand Tailings Area B", fill material is available from small dikes in the southern portion of the area and a small height of land located near the center of the restoration area. In this situation, similar to Sand Tailings Area A, the material available from these areas should also provide a surplus for use in filling deposits in the Cottonwood Creek floodplain south and east of the area. The slopes excavated for removal of contamination at the northern and eastern part of the area may exceed 3:1. Drawing Nos. 18 and 19 illustrate areas where regrading may be required to reduce slopes to the maximum inclination.



In "Pond 2 and on the Cheyenne floodplain" the fill material is available from existing dikes at the north end of the pond and regrading of the excavated slopes. The banks created during excavation along the southern portion of the area will range in steepness from 5:1 to slopes in excess of 3:1. By regrading these slopes to a uniform 5:1 inclination, sufficient fill material will be available for the cover required in the adjacent pond bottom.

The bank slope along the Martinez property at the west side of the area may also exceed 3:1. To remain within the mill site boundaries and provide a maximum 3:1 slope for restoration, this area may require filling and regrading in localized areas.

In the "Pond 1 and Cheyenne floodplain area" filling is required to provide cover for the base of the pond and provide drainage into the Cheyenne River. The dike along the north edge of the pond will provide sufficient material for this use and possibly leave a surplus. The remaining surplus portion of the dike should be utilized to extend the slope of the valley walls below the dike to provide positive drainage from the recontoured pond base.

At the "East Sand Tailings Pile", the dike along Cottonwood Creek will provide a portion of the fill required. The remaining fill will be acquired from the steep banks along the east and south part of the area by regrading to a 5:1 slope. By regrading these banks, no area within the East Sand Tailings Pile will exceed the maximum 3:1 slope.

Areas below groundwater should ideally be filled with sandy silt material in order to achieve good compaction during placement. However, the local silty clays may be used for this purpose, provided that these areas are maintained in a dewatered condition until filling is completed, and provision is made to reshape the restored landform should settlement take place.

As some filling will be required against banks created during excavation and in order to reduce the potential for slope failures, provision should be made for placing a local filter blanket constructed of two feet of pit run gravel against the bank where existing alluvial sand and gravel aquifers are intersected.

Regrading (cut and fill operations) will be carried out using scrapers and bulldozers. Fill placement to build slopes should be limited to 12-inch lifts compacted with a sheeps-foot roller in the case of silty clays and a steel wheeled roller in the case of cohesionless soil. On flat or gently sloping areas, material should be placed in maximum 2-foot lifts and compacted by the placement equipment.

#### 6.2.2 Diked Areas on Relatively Flat Upland Locations

Restoration areas:

- Pond 3 and Adjacent Sewage Lagoon Area
- Ponds 4, 5 and 6
- Pond 7
- Pond 8 and Adjacent Sewage Lagoon Area
- Pond 9
- Pond 10



In these areas, the primary source of fill material is from the existing dikes. However, in most cases, the dikes do not provide sufficient material to fill depressions, apply a 2-foot layer of cover over residual contamination and provide adequate slopes for drainage. Additional fill material to meet this deficit cannot be taken from borrow areas within the restoration sites without extensively altering the landform. For this reason, fill material from the disposal site will be acquired to compensate for the lack of material on-site.

In "Pond 3 and the Adjacent Sewage Lagoon Area" the required fill for restoration is available from regrading at the east side of the pond and from the dikes along the north, west and south boundaries.

In "Ponds 4, 5 and 6", some minor excavation will be necessary to meet the drainage requirements in the western portion of that area. The east portion of these ponds will require a shallow filling. Although some fill is available from within the restoration area, additional material will be required.

In the restoration of "Pond 7", "Pond 9" and "Pond 8 and Adjacent Sewage Lagoon Area", the dikes supply only a portion of the fill requirement and considerable additional material will be needed from the disposal site.

In "Pond 10", a large depression was excavated in the northeastern corner to provide material for the original dike

construction. During decommissioning this area will be deepened by two feet. The fill material available from the dike will provide only a portion of the fill required to level this depression and cover the remaining portion of the pond with a 1-foot cover (see Section 4.8). Additional fill material will be required for restoration grading, as shown on Table 6-1

It is anticipated that most of the restoration grading in these areas will be carried out using scrapers and bulldozers. Material spreading and compaction efforts should follow procedures suggested in Section 6.2.1.

#### 6.2.3 Open Areas Requiring Little or No Regrading

Restoration areas:

- Mill Building Area
- Open Area South and East of Pond 1
- Pine Hills Area
- Primary Mill Site Haul Road and Maintenance Area

The excavation required to remove surface contamination in these areas will normally be shallow. An exception is the Mill Building Area where deeper excavations are required in association with the removal of contamination beneath foundations, etc.

In the "Open Area South and East of Pond 1" and "Pine Hills Area", the shallow excavations do not significantly change the land contours and no additional grading will be required to fill depressions and provide drainage.

In the "Primary Mill Site Haul Road and Maintenance Area" only minor restoration grading will be required to remove the haul road and restore the maintenance area.

At the "Mill Building Area" depressions created by excavations beneath mill structures will require filling to a level grade. Material for this can be obtained from the existing truck ramps. Also, minor filling and excavations will be required in some locations to provide a uniform one per cent slope for drainage to Cottonwood Creek or the Cheyenne River.

#### 6.2.4 Cottonwood Creek Floodplain

Restoration area: • Cottonwood Creek floodplain

Material is required in the creek floodplain to fill depressions and provide a minimum slope into the creek. Fill material will be provided from adjacent restoration areas and dike materials used for stream diversions as discussed in Sections 3.4 and 6.2.1. The final restoration grades are shown on Drawing Nos. 16 and 17.

#### 6.2.5 Haul Roads

Restoration area: • Off-site Portion of Primary Haul Road

Following removal of any contamination that may be found on the off-site portion of the primary haul road to the disposal site as discussed in Section 3.7, the remaining portions of haul road and ditch will be graded over and the site generally restored to the landform which existed prior to road construction.

### 6.3      Drainage

The main objectives for providing drainage on the mill site involve grading to a one per cent minimum slope and ensuring runoff is not increased onto neighboring lands, particularly Cottonwood Community.

The restoration plan, (Drawing Nos. 18 and 19) shows the northern portion of the mill site draining into the Cheyenne River floodplain through the restored Ponds 1 and 2. The area east of Cottonwood Creek including the northern portion of the Pine Hills Area, and restored Ponds 7, 8 and 9 drains northeasterly to the restored Pond 3 area and into the Cottonwood Creek through what was once the East Sand Tailings Pile area. To allow this drainage pattern, a wide shallow swale must be excavated along the east side of Pond 3 with a minimum slope for drainage into the East Sand Tailings Pile area.

The area west of Cottonwood Creek, east of the railway and south of the Cheyenne River drainage area slopes through Sand Tailings Areas A and B into Cottonwood Creek.

The drainage from Pond 10 and the southern portion of the Pine Hills Area is directed south of the Cottonwood Community overland to Cottonwood Creek.

In certain sections of the restored Ponds 7 and 8, slopes range from one-half to one percent. Although these slopes are less than the suggested one percent minimum, this situation occurred naturally on the site before milling operations and will not significantly affect site drainage.

#### 6.4      Topsoil

Table 6-2 provides a summary of the topsoil sources and the quantities required for restoration grading (assuming a 6-inch cover) within the mill site, disposal site and haul road. Table 6-1 summarizes the topsoil quantities required within each restoration area of the mill site. These requirements are shown on Drawing Nos. 18 and 19.

There is a deficit of 79,900 cubic yards of topsoil, considering the topsoil available from stripping operations. To provide additional topsoil, a borrow area northeast of the mill site was identified as illustrated on Figure 2.1 of the FES (Ref. 6). To avoid the use of this area and the associated disruption, it is recommended that surplus soil from the disposal site be used to meet the projected deficit, as suggested in Section 3.8 of the FES. The FES recommends that soil meeting the standards established by the Wyoming Department of Environmental Quality be used as topsoil (i.e. plant growth media). Soil testing will be required to determine what soil treatment is required to raise available soils at the disposal site to an acceptable quality. In some instances, where topsoil is no longer available, the fill material used in the restoration grading may be upgraded and no additional covering of plant growth media will be required.

Topsoil will provide the best media for plant growth and should be used in all key restoration areas where rapid plant growth is desired for soil stabilization.

TABLE 6-2

SUMMARY OF TOPSOIL SUPPLY AND REQUIREMENT VOLUMES (cu. yd.)

Available source areas\*

Disposal Site	120,800	
Off-Site Haul Roads	25,300	
Facilities Area	<u>19,300</u>	
	165,400	165,400

Topsoil requirements (assuming approximately 6" of cover)

Disposal Site	58,600	
Haul Roads	12,700	
Mill Site and		
Facilities Area	<u>174,000</u>	
	245,300	245,300

Topsoil Deficit 79,900

Surplus silty clay soil at  
Disposal Site suitable as  
growth media 92,300

- \* Considering that the topsoil would be stripped to an average depth of one foot in each of these areas. (Report Nos. 7, 11a and 11b, Ref's. 12, 14 and 15).



## 6.5      Seedbed Preparation and Seeding

All areas within the mill site will require a plant growth media application with the exception of undisturbed areas and the Pine Hills Area where shallow excavations should leave sufficient topsoil depth.

Sections 2.2.2.7 and 2.2.3.8 of the FES (Ref. 6) describes the seeding requirements for the mill site through a summary of Sections 4.6.3.2 and 4.6.3.3 of the Environmental Report (Ref. 19).

This description addresses the following issues:

- Planting and seeding periods
- Seed mixtures for the mill site and banks of the Cottonwood Creek.
- Seed mixtures and procedures for temporary seeding
- Shrub species and planting methods for the banks of the Cottonwood Creek
- Application rates and anchoring methods for straw mulch
- Ripping the soil surface before application of top soil
- Disking after top soil application.

## 6.6 Soil Stabilization

During and immediately after restoration grading and the application of the plant growth media, the soil surface will be susceptible to erosion from wind, local overland flows, and localized flooding of Cottonwood Creek and the Cheyenne River. Monitoring of soil conditions will be required and provisions must be made to repair areas of soil instability.

The primary soil stabilization method involves ripping the subsoil surface, disking the top soil, applying straw mulch and using temporary seedings as described in Section 2.2.2.7 of the FES (Ref. 6).

The restored upland areas surrounding the Cottonwood Creek floodplain are generally flat with slopes in the range of one per cent. This condition is unlikely to produce overland flows which will cause erosion of the steeper banks in the Cottonwood Creek valley. Localized channelization may occur in some areas and some additional maintenance and restoration may be required.

In the Cottonwood Creek floodplain, moist soil conditions along the valley floor will promote seed germination and plant growth. Until the temporary seedings or the recommended seed mixture are well established, some loss of newly-applied topsoil and seed may be expected during flood conditions. To prevent this occurrence and any erosion from localized overland flows, the use of a tackifying agent with the straw mulch or an erosion control matting may be required.

In the upland flat areas surrounding the Cottonwood Creek, the recommended soil preparation, mulching, and temporary seeding should provide adequate protection from overland flows and wind erosion.

The Pine Hills area may produce significant overland flows due to the soil conditions, steepness of slopes and length of slopes. The FES recommends water spreading bars to disperse overland flows into more level areas of Ponds 7, 8 and 9. In addition to these devices, other soil stabilization techniques may be required, including:

- Tackifying agents in the straw mulch
- Terracing
- Erosion control matting
- Diversion ditching and/or
- Straw bale berming.

#### 6.7      Staging of Restoration and Monitoring

Each restoration area should be rehabilitated as soon as possible after completion of excavation. Rehabilitation scheduling should correspond with spring and fall planting periods as discussed in Section 2.2.2.7 of the FES. Areas adjacent to the Cottonwood Creek which are susceptible to flooding should remain undisturbed as long as possible and be restored as quickly as possible to reduce potential soil erosion. Irrigation of newly-seeded areas may be required to encourage germination and plant growth. Details on the scheduling are addressed in Chapter 7.

Monitoring programs are presented in Section 4.2.3 and 4.2.7.2 of the FES for soils and terrestrial biota. The "soils will be monitored for their potential for erosion and physical and chemical properties that may affect plant growth". The plant cover and species diversity will be monitored using the sampling method described in the FES.

Each of the programs should be initiated at the completion of restoration in each area.

Monitoring of initial restoration sites may lead to modifications in the seedbed preparation, planting and the use of soil stabilization techniques for subsequent sites.